Task II.1 Integrative Approach to Understanding the Causes of Salt Marsh Dieback: Determination of Salt Marsh Species Tolerance Limits to Potential Environmental Stressors and Simulation of Salt Marsh Dieback - Photosynthetic Response.

Contact Name(s): Mark W. Hester, Jonathan M. Willis

Contact Affiliation/Info: Coastal Plant Sciences Laboratory, Department of Biological Sciences, University of New Orleans ((504) 280-6740; mhester@uno.edu, jwillis@uno.edu)

Participating Investigators/Affiliation: Irving A. Mendelssohn and Ray Schneider Louisiana State University; Karen McKee, National Wetlands Research Center, USGS

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Funding Source: NOAA through the Louisiana Department of Natural Resources

Study Site Location(s): Greenhouse and growth chamber studies at LSU and National Wetlands Research Center, Louisiana

Keywords: *Avicennia,* Climate, Greenhouse, *Juncus,* Salinity, *Spartina,* Soil chemistry, Toxins

Project Type: Experimental

Project Outline:

Specific Aims: To determine the interspecific variation in photosynthetic response of dominant Louisiana salt marsh species to potential stressors through single- and multi-factor tolerance trials. Note that these studies were conducted within the framework of the whole-plant response studies (Task II.1, summarized by Mendelssohn) and utilized photosynthetic response as a supplemental stress indicator in addition to the whole plant response. Specific questions examined include:

- What are the tolerance limits of *S. alterniflora* and other salt marsh species to potential environmental stressors (salinity, moisture, pH, toxic metals)?
- What multiple-factor interaction causes mortality of *S. alterniflora*, but not other salt marsh species?
- What combination of environmental drivers (soil type, hydrology, and salinity) will cause mortality of *S. alterniflora*?

Methodology:

- Approach
  - Growth chamber and greenhouse experiments

- Species
  - *Spartina alterniflora*
  - *Avicennia germinans*
  - *Juncus roemerianus*

- Stressors
  - Salinity, Acidity, Moisture, Fe, Al

- Treatments
  - Increasing stressor level
  - A constant but elevated stressor level
  - Control

- Growth conditions
  - Sand culture in plant growth chambers and greenhouses under relatively controlled and near optimal conditions

Results to Date:

- Salinity
  - Net CO_2 assimilation rates indicate that *Avicennia germinans* is the most salt tolerant, followed by *Spartina alterniflora*, with *Juncus roemerianus* being the least salt tolerant.
- Moisture Deprivation
  - *Avicennia germinans* appeared to have the greatest tolerance to moisture deprivation, followed by *J. roemerianus*, which was followed closely by *S. alterniflora*.
- Acidity
  - *Juncus roemerianus* demonstrated the greatest tolerance to acidity, with *A. germinans* having greater tolerance to moderately low acidity than *Spartina alterniflora*, although *A. germinans* and *S. alterniflora* were intolerant of very low acidity.
- Fe Toxicity
  - *J. roemerianus* also demonstrated a high tolerance to iron, with *A. germinans* being less tolerant, and *S. alterniflora* being the least tolerant.
- Al Toxicity
  - Overall, all plants demonstrated a high tolerance to aluminum, with *J. roemerianus* having the by far the greatest tolerance. *Avicennia germinans* appeared to have a slightly greater tolerance to Al than *Spartina alterniflora*.

Lessons Learned:

- Overall, the photosynthetic data agree with and support the whole plant response data.
- The moisture deprivation, moderate acidity, iron toxicity, and aluminum toxicity, results are most consistent with field observations during the marsh dieback event. The photosynthetic responses to increases in salinity are inconsistent with field observations, and therefore salinity is unlikely to have been solely responsible for the salt marsh dieback phenomenon.
- We propose that soil drying resulted in increased acidity, which released Fe/Al to toxic levels. Also, an osmotic stress, generated by the drought conditions may have also been involved in the dieback.

Publications, reports, or web-accessible materials: *Please refer to* http://www.brownmarsh.net

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